Creating A Dynamic DCF Analysis: A Detailed Excel Approach Utilizing Monte Carlo Methodology

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ABSTRACT

The Discounted Cash Flow (DCF) analysis usually involves long-term asset valuations yet assumptions are made to allow static variables to be introduced into this potential dynamic model. This paper advances pedagogical literature by offering a detailed Excel walkthrough incorporating a Monte Carlo Simulation to account for changes in both the growth rate in free cash flows (FCF) and the cost of capital. The empirical results are startling as projects that 'pass' the NPV acceptance rule, reveal possible negative values or extremely low positive ones that would have gone un-noticed in a traditional DCF analysis and would have resulted in a non-acceptance decision. This paper posits and empirically shows that MCS complements the DCF with results that more closely approximate the 'true' net present value (NPV) by incorporating a set of dynamic variables that directly measure the anticipated cash inflow-outflow valuation relationship.

INTRODUCTION

In the area of valuation, the Discounted Cash Flow (DCF) method is widely viewed as an acceptable means to measure the net present value (NPV) of firms, projects, and securities (Downes and Goodman 1998). In a project valuation, the DCF is dependent upon determining the expected after-tax free cash flows associated with an asset and then discounting these cash inflows and outflows to find the aggregate net present value (NPV) contributing to the decision making process. The model's major components for valuation are the estimated future cash flows and the accompanying cost of capital (Seitz and Ellison 1999). In an academic setting, students use these to arrive at decisions of acceptance/rejection. These involve long-term valuations yet assumptions are made to allow static variables to be introduced into a potential dynamic model. This paper addresses the issue that the DCF is conducted under uncertainty and as such, the estimated future cash flows need to reflect deviations over the time horizon. A Monte Carlo Simulation (MCS) is utilized to account for changes in both the growth rate (g) in the free cash flows (FCF) and the cost of capital (k) of the asset. While 'canned' programs exist for the MCS, this paper advances the pedagogical literature by offering a detailed walkthrough of creating a DCF analysis based on a MCS in an Excel spreadsheet. The latter creates a normal distribution of at least one hundred different iterations based upon changing growth rates and cost of capital. The empirical results are startling as projects that normally 'pass' the NPV acceptance rule, reveal possible negative values or extremely low positive ones that would have gone un-noticed in a traditional DCF analysis and would have resulted in a non-acceptance. This paper posits and empirically shows that coupling the DCF and MCS together more closely approximates the ‘true’ net present value by incorporating a set of dynamic variables that directly measure the anticipated cash inflow-outflow valuation relationship. The complementary use of the Monte Carlo Simulation makes the DCF method a more precise and reliable means of asset valuation.

METHODOLOGY

Its important to note that in this analysis, the cost and expected free cash flows are correlated. If it were true that the cash flows were uncorrelated (meaning that each cash flow would be independent of each other), the DCF valuation process would not be able to use prior year’s growth in cash flows to estimate the future cash flow figures.
In an attempt to learn how a system will react in various scenarios, a simulation model can be introduced. Specifically, the Monte Carlo Simulation randomly selects data points “but with the probability that each draw is controlled to approximate the actual probability of occurrence (McLeish 2005).” Excel has the capability of creating a random number generator. As stated, management is uncertain about the expected growth (g) in its free cash flows and the impact of dynamic discount rates (k) over the investment horizon. Based on the latter and its relation to the known initial outlay, the net present value (NPV) is computed. With each random change in the (g) and (k) percentages, a new NPV is calculated. This procedure is duplicated one thousand times or iterations. The proportion of iterations that results in a range of NPVs, approximately equals the probability of that range of NPVs happening. A detailed excel walkthrough is available in the appendix.

A traditional NPV model is used to measure the present value of the expected future free cash flows but is modified here for random annual growth rates in these future cash flows. Netted against these is the present value of the cash cost outlay other than financing costs. Each cash flow is discounted at a dynamic average cost of capital. The net present value (NPV) is defined as:

$$NPV = \Sigma \frac{FCF_{t-1}(1 + g_r)}{(1 + K_r)^t} - I_0$$

where FCF_{t-1} = After-tax free cash flow of prior period t
g_r = growth rate in FCF randomly chosen
K_r = cost of capital randomly chosen
I_0 = initial outlay in time period zero

Example of future FCF: FCF_1 = \$200 (known period one cash flow)
$FCF_2 = (\$200*(1+g_r))$
$FCF_3 = FCF_2*(1+g_r)$

The key in being able to format Excel for a Monte Carlo Simulation for this DCF analysis is the formation of the two uncertain variables of (g) and (K). Both a mean and standard deviation are selected as a starting point. They can be assumed to be historical averages that management has calculated (Table 2). The proper excel formula, cells D8 and I8, with the random number creator is shown in Table 3 below:

Table 3: Set Up of Random Growth Rates (g) and Cost of Capital (K)

Uncertain Inputs	Cell Address	Creation of Random Variables for the Normal Distribution	Historical Averages	
g	**D8**	**=NORMINV(Rand(),mean,stddev)**	**3%**	**Mean**
			1%	**Std. Deviation**
K	**I8**	**=NORMINV(Rand(),mean,stddev)**	**14%**	**Mean**
			1%	**Std. Deviation**

The interesting and critical occurrence is that once the variables are determined, while seeming to be fixed at first, they will continue to change as the excel spreadsheet is refreshed reflecting their randomness and ultimately helping to create the normal distribution in the Monte Carlo Simulation. A detailed walkthrough appears in the appendix showing how to run a Monte Carlo Simulation in an excel spreadsheet.

CONCLUSION

This paper advances pedagogical literature by conducting a DCF analysis that includes a detailed excel walkthrough (appendix) incorporating a Monte Carlo Simulation to account for changes in both the growth rate in free cash flows (FCF) and the cost of capital. The empirical results are startling as a project that ‘passed’ the NPV acceptance rule, revealed possible negative values and/or extremely low positive ones that would have gone un-noticed in a traditional DCF analysis. These results may now lead to a non-acceptance decision. A major argument of this paper is that the usual DCF Analysis, needs to be complemented with a Monte Carlo Simulation for a more thorough analysis. The absolute acceptance of a project where the NPV > 0 does not tell the whole story.

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